STRATEGY RESEARCH PROJECT

MAINTAINING A MILITARY TECHNOLOGICAL EDGE: TRANSFORMING THE ARMY TO THE OBJECTIVE FORCE

BY

COLONEL DOUGLAS GLOVER
United States Army

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U.S. ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013-5050

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COLONEL DOUGLAS GLOVER
United States Army

Professor Bernard Griffard
Project Advisor

U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

ABSTRACT

AUTHOR: COL Douglas Glover

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The key to maintaining a military technological edge which is needed to transform the Army to the Objective Force is directly related to a viable science and technology program. Current defense budgets have put previous science and technology programs at risk and required the defense industrial base to alter its business paradigms by downsizing, consolidating, and globalizing. As the defense industry pursues these new business paradigms, the Army has increased its reliance on the technological capabilities of the commercial sector. Consequently, specific measures must be taken to avoid the unintended export of military-unique or dual-use technologies in the pursuit of economic success. Therefore, the Federal government must harmonize its export control policy to ensure economic success does not compromise America's military technological edge as the Army transforms to the Objective Force.

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Throughout the Cold War, the Defense Department worked effectively with the defense industrial base to maintain the military's technological edge. In view of smaller defense budgets during the last decade of the 20th Century, the defense industry began to downsize and consolidate its operations. This change was necessary because the Defense Department lacked funds to support a large defense industrial base by making large equipment purchases or investing in relevant science and technology programs. The defense budget was reduced following the collapse of the Berlin Wall, which signified the end of the Cold War, and the gradual downfall of the Soviet Union. Subsequently, the Federal government saw no need to maintain a large defense budget because the enemy had been defeated.

Given the end of the Cold War and the downfall of the Soviet Union, America was anxiously anticipating her long-awaited dividends of world peace and stability. Regrettably, this did not occur. Instead, the post-Cold War world has been characterized by increased violence, uncertainty, and instability ranging from peacekeeping to major theaters of war. As the dominant land-based force in the Defense Department, the Army was challenged with fulfilling its responsibilities in support of the national military strategy in a world characterized by increased turmoil.

Given the reductions in defense dollars and force structure, the Army has pursued an innovative and affordable approach to protecting America's national interests. This approach exploits technology and leverages current and evolving expertise to transform the Army to the Objective Force: a more deployable, lethal, and technologically advanced combat force.

The key to transforming the Army to the Objective Force is technology. Accordingly, the Defense Department must pursue a viable science and technology program that supports evolving military needs and promotes technological superiority. Considering today's smaller post-Cold War defense budgets, the Defense Department must efficiently manage funds that are needed to research, develop, and field the Objective Force.[1]

America's industrial base has traditionally consisted of two separate industrial bases: the commercial industrial base and the defense industrial base. The primary difference between the two is that companies in the defense industrial base have worked closer with the Defense Department to provide supplies, equipment and weapon systems in support of America's national security. As we enter the 21st Century, however, both industrial bases will play a significant role in developing the technology to transform the Army to the Objective Force. The

expertise from both the commercial and defense industrial bases will generate two primary advantages: commercial technological leadership and years of defense-related knowledge and experience. The synergy of America's two industrial bases will combine the knowledge, experience, emerging technologies, market-driven strategy, and business processes into a cohesive effort that will provide the Objective Force with a military technological edge in the 21st Century.

The Defense Department must also make sure that the acquisition process facilitates, rather than restricts business opportunities in the commercial industrial base. All too frequently, professional publications have addressed excessive costs relating to Defense Department administrative requirements that commercial companies must absorb simply to conduct routine business. If the Defense Department subscribes to maintaining America's military technological edge, then it must continue to refine the acquisition process.

As the Defense Department improves the acquisition process, opportunities to use commercial products and exploit dual-use technology should also correspondingly increase, as it is only another opportunity for the Defense Department and the commercial industrial base to work closer together in developing products that have a dual application—military and civilian. Accordingly, the expanded use of commercial products in military equipment should lead to cost savings, improved technology, and economic success.

As the Defense Department integrates the commercial industrial base into transforming the Army to the Objective Force, it must not allow cost savings and economic success to compromise national security. Thus, as the Defense Department increases its reliance on the commercial industrial base, it must be prepared to assume a greater role in influencing export control policies and procedures. Consequently, this paper will address the challenges of maintaining the military's technological edge as the Army transforms to the Objective Force, while the Federal government balances the risks of economic prosperity and national security.

THE OBJECTIVE FORCE

The hallmarks of Objective Force operations will be developing situations out of contact; maneuvering to positions of advantage; engaging enemy forces beyond the range of their weapons; destroying them with precision fires and maneuver; and tactically assaulting enemy capabilities or locations at times and locations of our choosing.

—United States Army White Paper
Concepts for the OBJECTIVE FORCE

The national military strategy must provide a credible force that supports America's national security strategy as we launch into the 21st Century. The Army Chief of Staff has determined that in order for the Army to fully support the national security strategy, it must transform to the Objective Force. The Objective Force must be developed by exploiting the most advanced technology available in the commercial industrial base or collectively available in the commercial and defense industrial bases. Accordingly, the Objective Force must be prepared not only to achieve victory in major regional conflicts but to also be prepared to be a dominant force in smaller-scale contingency operations, to include peacekeeping, throughout the world. Therefore, the Objective Force must use America's technology to become more deployable than our heavy forces, but more lethal and survivable than our light forces. [2]

The use of advanced technology will enable the Objective Force to conduct simultaneous and continuous combined arms operations in various terrain and weather conditions throughout the world. The use of technology to enhance battlefield situational awareness will improve the Objective Force's versatility, lethality, and agility in close combat operations. Subsequently, this leap-ahead capability will establish a new paradigm in which the Objective Force will revolutionize the synergy of mobility, maneuver, firepower, and protection.[3]

The Objective Force will eliminate the Army's polarization of its light and heavy forces. Currently, light forces are strategically mobile but lack lethality, survivability, tactical mobility, and staying power. Heavy forces are survivable and lethal but lack tactical mobility and operational agility in some environments without large quantities of logistics—fuel, ammunition, and repair parts.[4]

A major goal of transforming the Army to the Objective Force is to exceed the current capabilities of heavy and light forces. The Army wants to maintain reliable sustainment. It wants to combine heavy force speed, firepower, combined arms capability, and survivability with light force versatility, deployability, and dismounted close combat skills. Achieving this goal will ultimately allow the Objective Force to dominate the battlefield by destroying the enemy and controlling key terrain.[5]

A strong science and technology program will support evolving military needs and ensure technological superiority over potential adversaries. Accordingly, the Defense Department must convince the leadership in this country of the benefits of providing the basic research that is needed to transform the Army to the Objective Force. The Secretary of Defense appears to be in agreement with these thoughts and has captured the importance of a strong science and technology program in the current edition of the *Quadrennial Defense Review Report* in which

he is promoting an increase in the funding for science and technology programs to a level of three percent of Defense Department spending per year.[6]

The Defense Department must maintain its momentum in promoting a strong science and technology program that is responsive to transforming the Army to the Objective Force. Undoubtedly, the Defense Department will need the assistance of other Federal agencies as well as businesses in the defense and commercial industrial bases. Consequently, this coordinated effort must be driven by an integrated strategy in which everyone shares responsibility in the following areas: (1) maintaining a technological superiority in warfighting equipment that supports our national military strategy; (2) providing technological solutions to achieve the future joint warfighting capabilities identified by the Joint Chiefs of Staff; (3) balancing basic research and applied technology so that future investment decisions will support emerging technologies that reveal the most promising payoff areas; and (4) incorporating affordability as a design parameter so that the cost of advanced technology does not catapult out of control.[7]

RESEARCH AND DEVELOPMENT: A NEW APPROACH

During the Cold War, important new defense technologies usually arose from research and development primarily sponsored and funded by the Defense Department within defense companies, think-tanks and universities located in the United States. Today, new defense systems are developed when defense companies embed commercially developed technology into weapon systems. This new approach to the nation's defense has profound policy and funding implications. According to the National Science Foundation, the amount of money spent on scientific research and development in the 1980 Western world was about $240 billion (in 1999 dollars), evenly divided between the United States and its G-7 partners--Japan, Germany, France, Italy, United Kingdom, and Canada. The U.S. Defense Department sponsored about $40 billion, or fully one-sixth of the total. In the year 2000, the corresponding global total for research and development spending was 360 Billion. The United States still accounted for half this amount, which was roughly $180 billion. [8]

Research and development funding to develop the next generation of military capabilities was projected to be only 14 percent of the budget authority in Fiscal Year 95 with a possible decrease to 11 percent in Fiscal Year 99. This decrease presents the biggest challenge to maintaining a large, expensive military force structure. Its current costs, when emerging threats are low, preclude necessary investments for the future when threats, although only dimly perceived now, will certainly exceed current capabilities. Consequently, the Defense

Department needs to aggressively pursue investment opportunities with the commercial sector in order to get the biggest return in research and development efforts that will be needed to transform the Army to the Objective Force.[9]

An effective research and development program sets the stage for the invention of products and processes and brings those inventions to the point of commercialization. Over the years, America has not consistently maintained a strong investment in research and development. Meanwhile, foreign competitors of the United States have been devoting increasingly more shares of their gross national product to research and development. For example, Germany and Japan have both increased their share of gross national product that is applied to research and development, so they are closing the gap with the United States. However, they are not necessarily applying these increases toward defense spending. [10]

A significant portion of the Defense Department's research and development spending is being used for downstream engineering of mature systems rather than for research into new enabling technologies (88% development and 12% research in 2000 versus 69% and 31%, respectively, in 1980). Independent research and development conducted within defense companies and cost-shared with the Defense Department, which used to be a means for keeping defense companies innovative, is also declining. All of these indicators point to one fact: tomorrow's defense innovations will be, in large part, derivatives of technology developed and marketed by commercial companies for commercial motives. To reinforce this point, consider the purchase of software. The more customers that purchase a certain software program, the more valuable the program becomes. Consequently, the software market thus tends to have a winner take all character. Since the Defense Department is a small portion of the overall software market, it has no alternative but to adopt the most popular software systems. The alternative would be to develop its own software, which would inevitably be inferior and more costly than the widespread commercial versions. [11]

While government research and development remain important, commercial research and development are now just as important, if not more. In relevant areas, the Defense Department shares a 50-50 investment cost with commercial partners. About 25 percent of the funds for a project come from the Defense Department's $30 million annual budget for the pilot program. Another 25 percent come from the Service laboratories. The balance comes from non-federal sources, primarily industry. Rather than designing technology specifically for the military, civilian officials incorporate defense considerations into commercial designs. For example, the Army's Night Vision and Electronic Sensors Directorate and Indigo Systems Corporation have developed a six-ounce infrared camera about the size of a D cell battery that could be mounted

on smart munitions to provide greater accuracy, and on helmets to provide night vision. The Defense Department says the camera is already in high demand by civilian fire departments for its ability to see through smoke. Another example involves the development of an antenna by the Air Force and Raytheon Systems Company: It can be used for weapon system delivery and for cellular communications. Consequently, telecommunications companies have already deployed about 5,000 of the antennas. Both of these examples represent a successful partnership with industry and are models of dual-use technology. [12]

REFORMING THE ACQUISITION PROCESS

The Federal government has taken steps to improve the acquisition process so that the Defense Department can take advantage of cost savings and advanced technology offered by the commercial sector. Accordingly, the Federal Acquisition Streamlining Act of 1994 was signed into law to reform the acquisition system. Its most important feature facilitates the Defense Department's acquisition of commercial products. [13]

Though the Federal Acquisition Streamlining Act of 1994 eliminated some unnecessary bureaucratic requirements, acquisition reform still requires further changes. These changes are needed so that the Defense Department can benefit from reduced cycle time, faster insertion of new technology, and support from a large and robust commercial industrial base. It is becoming increasingly more acceptable for many of the technologies that are critical to military systems to be provided by the commercial industrial base, particularly considering their pace of innovation and technological development. If the Defense Department intends to field state-of-the-art weapon systems in a cost effective manner, then it must incorporate commercial products into these weapon systems.[14]

COMMERCIALIZATION

Achieving and maintaining successful partnerships with the commercial industrial base must become a top priority for the Defense Department, especially in the area of computer and semiconductor technology. In fact, new technologies that are most critical to our military advantage--software, computers, semiconductors, and telecommunication--are being driven by fast-growing commercial demand, not by military demand. Even though defense and commercial products often diverge, many of the technologies critical to military superiority are identical to or closely allied with technologies that are vital to commercial industry, and that convergence is increasing. Consequently, this presents the Defense Department an excellent opportunity to exploit dual-use technology. [15]

DUAL-USE TECHNOLOGY

Dual-use technology reflects the reality that our nation can no longer afford to maintain two distinct industrial bases--defense and commercial. Rather, it allows the armed forces to exploit the rapid rate of innovation and market-driven efficiencies of the commercial industrial base to meet defense needs. The strategy of drawing on commercial technology and capabilities and using superior systems design and integration skills of the defense industrial base affords the Defense Department the opportunity to do its job more effectively and economically. Dual-use technology goes beyond simply incorporating commercial off-the-shelf parts and equipment in military weapon systems. It involves a fundamental shift toward technology that satisfies both commercial and military needs for lower costs and higher quality, as well as increased performance. Using components, subsystems, and technologies developed by the commercial industrial base in our military weapon systems enables the Defense Department to attain three compatible objectives: (1) access to leading-edge technology during the development and throughout the life cycle of our military weapon systems, (2) affordability by eliminating customized, military-driven technology, and (3) the ability to rebuild military capabilities to a higher level if necessary in the future. [16]

The Defense Department is expanding its business opportunities between the military and the civilian world through research and development partnerships with corporate America. Since 1997, the Defense Department has initiated 283 joint projects to develop technology that can be used by the military and private industry. The Defense Department has invested about $400 million through its Dual-Use Science and Technology Program. Corporate America has invested another $440 million in the program. Maintaining technological superiority on future battlefields depends on the Defense Department's ability to take advantage of technology advances occurring in commercial industrial base. If the Defense Department wants to take advantage of the efficiencies, innovation, reduced cycle time, and lower cost technologies coming out of the commercial industrial base; then they must make the use of dual-use technology an essential component of their research and development efforts. [17]

THE DECISION TO DOWNSIZE AND CONSOLIDATE THE DEFENSE INDUSTRIAL BASE

Over the past ten years, the defense industrial base has undergone significant changes. Reduced military spending, declining sales and excess capacity prompted practically all defense companies to downsize and consolidate in order to remain competitive and financially viable. However, while the Defense Department strongly encouraged downsizing and consolidating, it also wanted to maintain some level of competition, innovation, and control. Otherwise, it would

become cost prohibitive to purchase products from the defense industrial base, particularly when the Defense Department has to rely on a smaller defense budget.[18]

Once the effect of fewer defense dollars became a reality, companies that comprised the defense industrial base made some tough business decisions in order to ensure economic survival. Specifically, from 1990 to 1998 the reduction of companies in the defense industrial base reflected in Table 1 undoubtedly poses an obvious question: Have we gone too far with downsizing the defense industrial base and possibly jeopardized our technological edge? Or have we simply right-sized the defense industrial base?[19]

Sector	Reduction in Companies (1990-1998)
Tactical Missile	13 to 4
Fixed-Wing Aircraft	8 to 3
Expendable Launch Vehicles	6 to 2
Satellites	8 to 5
Surface Ships	8 to 5
Tactical Wheeled Vehicles	6 to 4
Tracked Combat Vehicles	3 to 2
Strategic Missiles	3 to 2
Torpedoes	3 to 2
Rotary Wing Aircraft	4 to 3

TABLE 1- DEFENSE INDUSTRY CONTRACTORS

A superficial analysis of the numbers in Table 1 indicates that competition, innovation, and America's technological edge may suffer as a result of fewer companies within the respective defense industrial base sectors as of 1998. If the companies that are currently aligned within these respective defense industrial base sectors cannot economically survive, then the only options are to cut additional overhead costs (excess capacity, personnel, research and development), outsource, increase reliance on the commercial sector, globalize, or perform a combination of any of these options.

In an era characterized by consolidations, globalization, rapid technological changes and large profit earnings, defense industries can no longer regard themselves as indisputable national assets that are primarily supported by large defense budgets. The days of governmental reliance have been replaced with international collaboration and globalization for economic survival. Consequently, globalization is changing the world's defense-industrial landscape with remarkable rapidity. Based on the Defense Department's recommendation to downsize and consolidate the defense industry, a small group of 'mega primes' and 'semi

primes' now dominate the United States defense industrial base. Unmistakably, downsizing and consolidating within the defense industrial base was definitely the right approach, but have we lost too much of our technical expertise in the defense industrial base, or just a significant percentage?[20]

Though companies in the defense industrial base took appropriate steps to gain efficiencies by adopting 'lean manufacturing' processes, reducing overhead costs and improving business relationships between prime contractors and sub-contractors, they are still falling behind in technological innovations and business efficiencies. Furthermore, increased competitive market conditions have established the conditions for another round of consolidations at the international level. Consequently, the world's defense industrial base was consolidated into four major defense prime companies and a select group of semi-primes and specialist high-level subsystems suppliers: BAeSystems, Lockheed Martin, Boeing, Raytheon, General Dynamics, EADS, Northrop Grumman, GE-Honey, Thomson-CSF, and TRW. This consolidation was a big boost for globalization and economic prosperity, but it further diminishes the significance of national borders and our control of domestic technological advances. [21]

GLOBALIZATION

Globalization has significantly contributed to the development of a new defense industrial base paradigm. For the most part, large defense companies still tend to be national in their orientation, but their suppliers of technology and subsystems are increasingly becoming international or global companies. These companies share no national allegiance. They focus solely on increased customer sales, profits and earnings. For example, India is quickly becoming the world center of software engineering. Their abundance of engineers, combined with low wages, suggests that under current trends India will soon surpass the United States in lines of computer code it produces that will eventually find their way into widespread commercial and potentially defense applications furnished to the Defense Department by supposedly American companies.[22]

As a result of this trend, it is becoming more of a challenge for American companies to consistently support Presidential Decision Directive 34, which places economic objectives secondary to national military objectives. However, as each day passes, it is becoming more and more evident that one of the keys to economic survival is global trade, even for companies that have traditionally been a part of the defense industrial base.[23]

Participation in global markets provides an opportunity to increase profits and earnings. Consequently, as part of their new business paradigm, companies in the defense industrial base

have shown an interest in global markets. Specifically, companies in the defense industrial base export about one-quarter of their production, whereas European companies tend to sell between half and three-quarters of their output abroad. Thus, it appears that national security has taken a back seat to increased sales, economic prosperity, and market globalization. Unfortunately, market globalization has created two sources of trans-Atlantic tension. First, American and European companies compete for sales throughout the world. Secondly, disagreements between European countries and the United States on categorizing foreign customers who might end up as foes rather than friends are amplified by the pressure on both American and European companies to sell enhanced versions of military weapons to third-world countries. For example, the ability to procure air defense and anti-ship capability on the open market has increased dramatically in recent years because the United States and its global partners have not been able to agree on export controls. [24]

The rapid globalization of supply chains and the use of commercially developed technology are making it increasingly difficult to determine national origins of many defense components and subsystems. Consequently, this has generated a growing concern for national security at the expense of economic prosperity. Therefore, the United States must maintain a certain level of regulation to ensure mergers and acquisitions at the prime and upper subsystems-supplier level do not detract from national security. [25]

Contrary to some security challenges, globalization offers numerous benefits. Specifically, globalization provides the potential for an increased customer base, reduction in costs, and increased profits. To enjoy the benefits of globalization, the United States will have to address three problem areas that are certain to arise. First, we must address the problem of eliminating technical jobs in America's defense industrial base while simultaneously contributing to the creation of increased technical jobs in other countries. Secondly, American policy sharply limits foreign companies from exercising foreign ownership, control or influence over defense companies that deal with classified information. This is especially true when American companies that are acquired by a foreign company participate in highly classified compartmented or 'black' programs. The salient point is a matter of trust in the ability of allies to protect secrets. The final problem arises when the United States and an ally with whom it has a defense business alliance might not agree on the sale of items produced jointly to a third destination. Basically, these items are categorized as re-exports of American technology from the foreign company or joint venture.[26]

RESTRICTING THE EXPORT OF TECHNOLOGY

As we move into the 21st Century, most technology used by the Defense Department will be drawn from the commercial sector. Additionally, that technology will not come from just American companies, but from a global base. Thus, American denial of that technology to all potential adversaries will be almost impossible. Therefore, it must be understood that in some situations potential adversaries may have access to the same technology as the United States. Accordingly, it becomes paramount that the United States must take all prudent steps to control the export of military related technology.[27]

EXPORT CONTROL KEY PLAYERS

Export controls are our first line of defense against conventional arms proliferation. Basically, the goals of the United States export control system are to (1) identify technologies and products that need to be controlled, (2) review and evaluate export license applications, and (3) enforce export controls. Therefore, the United States must have organizations and procedures in place to systematically and methodically control the management of exports. [28] The United States export control system is administered by two agencies--the Commerce Department and the State Department. These two organizations work very closely with the Defense Department to enforce laws pertaining to the United States export control system.

The Commerce Department executes its export control responsibilities in accordance with the Export Administration Act of 1979, as amended. It provides policy on licensing sensitive dual-use items and on promoting trade with all countries that have diplomatic or trading relations with the United States. The Commerce Department maintains the Commodity Control List (CCL), and in consultation with the Defense Department and other applicable agencies, reviews license applications and makes decisions. [29]

The State Department executes its export control responsibilities in accordance with the Arms Export Control Act. It provides policy for designating items and services identified as defense items and services. It provides guidelines on the International Transfer in Arms Regulations (ITAR), United States Munitions List (USML), and Missile Technology Control Regime (MTCR).[30]

In accordance with the Export Administration Act of 1979, as amended, the Defense Department plays a key role in the export control process. It maintains the Military Critical Technologies List (MCTL) that provides a listing of items that should not be exported without further study. The additional time that is needed to conduct this study is particularly important

because the MCTL serves as an input to the ITAR that is maintained and administered by the State Department and the CCL for dual-use technologies, which is maintained by the Commerce Department. [31] Furthermore, the Defense Department feels compelled to review export license applications to (1) monitor the potential for products and technology to be diverted, (2) evaluate the diversion potential of an end-user, and (3) assess the validity of an applicant's statement certifying the end use of the product. [32]

EXPORT CONTROL CHALLENGES AND RISKS

A superficial view and understanding of America's export control system may indicate total compliance to stringent export control policies and procedures. Unfortunately, this is not always the case. To support this point, I have provided three different examples of how relaxation and liberalization of our export control policies can lead to serious repercussions and jeopardize our military technological edge. The first example involves the relaxation of our export control policies on certain dual-use technologies—for instance, satellites. The transfer of export licensing authority during the Clinton Administration from the State Department to the Commerce Department led to improvements in China's missile systems. As a result of these improvements, China can now strike the United States with multiple warheads and improved accuracy. This error led to the return of licensing authority to the State Department, followed by Federal efforts to withstand unnecessary pressure to move quickly on licensing decisions and rushing America's participation into globalization.[33]

Another example of relaxing our export control policies involves a form of re-exporting. China will develop an early warning and control radar system with the technological assistance from Israel, a strong American ally and security partner. Once these AWACS-like aircrafts become operational, they may serve as a command and control platform for aircrafts capable of launching missiles. This technologically advanced system of command, control, early warning, and high-tech weapons will undoubtedly be used to deter attempts by the United States to maintain peace and stability within the Western Pacific if China decides to carry out its threats to use force against Taiwan. [34]

Another example of re-exporting America's technology occurred when China was sold two AN/TPQ-37 Firefinder artillery locating radar sets by the United States in 1988. Within a year of their delivery, Beijing had cloned them and marketed a similar radar system, the Type-704, displayed at a major arms exhibition in China. The Chinese were also able to illegally acquire laser range-finders that closely resembled American equipment and installed them on their

Type-69 Main Battle Tanks. Subsequently, at least 100 to 200 of these tanks ended up in Iraq.[35]

As these examples show, it is obvious that America's military technological edge can quickly dissipate in the absence of strict export control policies and procedures. As the United States and the rest of the world become more technologically advanced in using computers to meet commercial and military requirements, the potential for our adversaries to compromise America's military technological edge significantly increases. Therefore, when it comes to computers and associated sensitive technology, United States export control policies must seek a balance between achieving economic prosperity and maintaining our military technological edge over potential adversaries. We must also deny the spread of technologies used in developing and employing weapons of mass destruction.

The importance of identifying potential national security risks with computer exports cannot be overly emphasized. Not only will advanced computer technology be among the most crucial elements in transforming the Army to the Objective Force, but it also plays an important role in some of our current and near-term prized weapon systems. For example, the Joint Strike Fighter aircraft has been designed using computers with 4,000 to 6,000 millions of theoretical operations per second (MTOPS). As of calendar year 2000, computers in this range can now be exported to military end-users in Russia or China without a license. Licenses for military end-users in these countries are required only for computers with performance levels above 6,500 MTOPS. Computers at 8,000 to 9,000 MTOPS are used for algorithm development for shipboard infrared search and track systems and modeling of submarine bottom designs for shallow water operations. A review of Table 2 reveals computer performance levels and associated applications. An important point, however, to this discussion is that key organizations involved with the export control system must conduct detailed research and provide well thought-out recommendations regarding the export of computers and associated technology and equipment. Undoubtedly, the decisions that will be made regarding the export of computers and associated technology and equipment will have a direct impact on transforming the Army to the Objective Force. [36]

Performance Levels of Computers that Support Selected Applications of Military Significance	
Computer Performance Levels (MTOPS)	Applications
4,000 – 6,000	Joint Strike Fighter aircraft design; non-acoustic antisubmarine warfare sensor development; advanced synthetic aperture radar computation.
8,000 – 9,000	Bottom contour modeling of shallow water in submarine design; some synthetic aperture radar applications algorithm development for shipboards' infrared search and track.
10,457 – 21,125	Nuclear Blast simulation
15,500 – 17500	Computational fluid dynamics application to model the turbulence around aircraft under extreme conditions.
20,000 – 22,000	Weather forecasting; impact of blasts on underground structure; advanced aircraft design

TABLE 2 – COMPUTER PERFORMANCE LEVELS

This impact is linked to America's tier system which is designed to control the export of high performance computers (HPCs): a crucial element in transforming the Army to the Objective Force. As of calendar year 1999, Tier one countries, which include Western Europe, Japan, Canada, Mexico, Austria, and New Zealand, can import any type of HPC without a license. Tier two countries, which include South America, South Korea, ASEAN, Hungary, Poland, Czech Republic, Slovak Republic, Slovenia, and South Africa, require an export license for HPCs that exceed 10,000 MTOPS. Tier three countries, which include India, Pakistan, the Middle East, the Magreb Union, the former Soviet Union, China, Vietnam, and the rest of Eastern Europe, require an export license for military and weapon end-users and end uses for 2,000 MTOPS. All other non-military users require a license for 7,000 MTOPS HPCs. Tier four countries, which include Cuba, Iran, Libya, North Korea, Sudan, and Syria, are not permitted HPC exports. License requirements for HPCs, however, are constantly being revised.[37]

Considering the technological applications and availability of HPCs and associated technology and equipment, it is paramount that the Federal government carefully manages the tier system and places national security above economic prosperity. To do otherwise is to negate the military technological advantages programmed for the Objective Force and subsequently compromise the national security of this country. Thus, in an era driven by consistent advances in technology, it is crucial for the Federal government, who is ultimately

responsible for balancing this country's economic prosperity with national security, to harmonize the export control policy in order to maintain our military superiority.

Another important aspect of maintaining our military superiority will require the Defense Department not only to control the proliferation of militarily sensitive technologies but also to invest in leading-edge technologies. Today's leading-edge technology will inevitably become the "mass market" technology in the future. Therefore, the Defense Department must establish close working relationships with the commercial industrial base and jointly contribute to a research and development program that will exploit technological advances needed to transform the Army to the Objective Force. The Defense Department must also look for opportunities to control the release of advanced technology into global markets. Otherwise, we will compromise our ability to maintain our military technological edge. [38]

Collectively, there appears to be a consensus that controlling high performance computers at some level is important to maintaining the national security of the United States. Consequently, the Defense Department needs to take the lead in articulating the specific national security interests that must be protected by controlling the export of military-related technology and high performance computers. Subsequently, the commercial industrial base must become more responsible and less aggressive in pursuing international markets for dual-use products. [39]

Additionally, the commercial industrial base must acknowledge that significant progress has been made to loosen the regulations governing the export of technologies, especially in the area of computers. Unfortunately, some representatives of the commercial industrial base continue to look for opportunities to reduce controls over exports. The insatiable quest for economic gain has driven some companies in the commercial industrial base to circumvent the export control system whenever possible to avoid having their license requests disapproved. [40]

Another facet of maintaining America's military technological edge in a global market place is the need to maintain some level of interoperability with our allies so that they can continue to work with the United States in maintaining regional stability. Unfortunately, there are situations in which the United States is not exactly amenable to technology collaborations with our allies, particularly because of the potential for allies to leak advanced military technology information to America's adversaries. Nevertheless, the Defense Department must take the lead in mitigating these risks in the interest of keeping the NATO Alliance together as a coherent fighting force.

CONCLUSION

Throughout the Cold War, the Federal government did an excellent job balancing this country's economic prosperity with national security. It accomplished this by maintaining a large defense budget and a strong defense industrial base that provided the military with its technological edge. Collectively, America's strong defense industrial base and its military technological edge contributed to the downfall of the Soviet Union.

The Federal government viewed the downfall of the Soviet Union as a victory for world peace and stability. Unfortunately, a world characterized by turmoil, uncertainty, and ambiguity replaced the threat posed by the Soviet Union. Without a clear definition of potential adversaries, the Federal government initiated a plan to systematically reduce the Defense budget and the Army's force structure. These reductions will have two significant impacts on the Army's ability to support the national security strategy. First, the Army must increase its reliance on the commercial sector to maintain its military technological edge. Given reduced defense budgets, the defense industrial base can no longer maintain its technological competitiveness. Secondly, the Army must transform itself to the Objective Force so that it can become a more capable and relevant combat force in the 21st Century. Unfortunately, traditional light and heavy forces are becoming less relevant in a world characterized by turmoil, uncertainty, ambiguity, and hostile situations which require rapid deployment and oftentimes sustained, lethal combat operations.

Transforming the Army to the Objective Force will not only require advanced technology that can be used in military weapon systems and equipment, but this same technology has a high commercial demand; thereby categorizing it as dual-use technology. Dual-use technology is the product of joint research and development teamwork between the Defense Department and commercial companies. It is a fundamental shift toward technology that satisfies commercial and military needs for lower costs, higher quality, and increased performance. If properly managed, it is the answer to continually maintaining the military's technological edge.

An important aspect of maintaining the military's technological edge involves computer technology. Computer technology will be among the most crucial elements in transforming the Army to the Objective Force. Consequently, the performance levels of computers, expressed in millions of theoretical operations per seconds (MTOPS), must be monitored for application in current and future U.S. systems against exports to foreign nations in accordance with America's tier system. For example, computers that operate at a performance level between 4,000-6,000 MTOPS are used in the Air Force Joint Strike Fighter aircraft design. As of calendar year 2000, Russia and China qualified for exports of HPCs that operate at the same MTOPs performance

level used in the design of the Air Force Joint Strike Fighter aircraft. Acknowledging this fact is alarming because of the countless years and resources that the U.S. has dedicated to controlling the Russian and Chinese threat. It has only been approximately 12 years since the U.S. won the Cold War. But the fruits of that victory are quickly slipping away as economic decisions are driving the U.S. to export relevant technology to the leading perpetuators of communism. The Federal government must not allow technology that is still relevant to the national security of the U.S. to be exported to countries like Russia and China under the auspices of globalization and economic prosperity. Undoubtedly, countries like Russia and China will take our technology and use it to undermine America's national security.

To protect America's national security, the Federal government must not allow export control decisions to be driven by globalization and economic prosperity. Rather, the Federal government must become more aggressive in controlling exports and export license requests as the military becomes more reliant on the commercial sector for advanced technology. The Federal government must unequivocally intervene and balance economic prosperity with national security. And the most effective method to do this is for the Federal government to harmonize its export control policy. It is only through harmonizing the export control policy that the Federal government can ensure that globalization and economic success do not adversely affect America's national security and the military's technological edge as the Army transforms to the Objective Force.

WORD COUNT = 6,465

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